Successful Learning in Schizophrenia, Functional Neuroimaging Studies, and Theoretical Considerations

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The following 4 articles are presented to promote a discussion about successful learning in people with schizophrenia. Because the psychotic components of this disorder routinely begin in adolescence and young adulthood and intrude throughout the person’s lifetime, it is difficult to know how a person anticipates, plans, and solves problems before, during, and after experiencing a prolonged psychotic illness. This is further complicated by impairments in cognition and motivation that may precede psychosis. Students of learning in schizophrenia are stuck with questions about neural compensation, neuroplasticity, and the distribution of poorly defined errors in neural function. Illness duration and medication effects also complicate these questions. Most people with schizophrenia are able to learn a wide range of skills and solve problems of daily living. But it is not at all clear why one person learns quickly and another does not, especially when they have similar symptom profiles and clinical backgrounds. And though the behavioral response to practice, with and without informative feedback, has been described in subjects with schizophrenia, the neurobiology that determines successful learning remains obscure.

In this collection, each of the 4 contributing research groups has a particular perspective on the biological patterns and rules associated with learning. Murray and colleagues1 and Rowland and colleagues2 consider the theoretical and experimental possibilities of alternative circuit participation. Each shows their affected subjects are able to learn successfully by relying on unconventional brain systems. Heinz and Schlagenhauf3 provide an extensive examination of dopamine’s role in sustaining feedback-mediated learning. They give special attention to dopaminergic signaling, intact and otherwise, that may support salience attribution. Their discussion of the potential relationship between learning and delusions provides a particularly creative approach to these complex phenomena. Koch and colleagues4 directly address how success in learning interacts with illness severity, with an emphasis on the various neural substrates that support different levels of skill acquisition. How various neural systems support learning in conjunction with different levels of psychopathology becomes a well-defined problem through their studies.

Murray and associates raise the important question of how increased neural “noise” in schizophrenia might diminish the investigator’s ability to measure indices of neural activity (e.g., Blood Oxygen Level Dependent response), manifesting in case-control group activation differences. It is reasonable to ask why signal variability should be greater in persons with schizophrenia. It is also reasonable to ask why the acquisition of a novel skill in adults with schizophrenia is seldom associated with robust responsivity in “conventional circuits.” In order to answer these questions, scientists must eventually use several methods to develop convergent evidence on the underlying causal relationships that determine success or failure. The biochemical flaws that give rise to suboptimal neurotransmission in schizophrenia are not fully defined. But by application of multimodal assessments investigators may develop ways to understand diminished signal transmission in one circuit and the homeostatic incorporation of another circuit. One region’s failure to participate and another region’s inclusion are likely to reflect the distribution and severity of biochemical flaws vital to optimal neurotransmission. The studies in this collection combine behavioral and neuroimaging measurements to interrogate learning processes in health and illness. Future studies will likely extend the findings presented here by integrating additional information, such as data from genetics, magnetic resonance spectroscopy, high resolution anatomical measures, diffusion tensor imaging, electrophysiology, and radiolabeled tracer measurements (positron emission tomography). By deconstructing brain–behavior relationships through carefully controlled studies that use multiple biological and psychological probes the field will advance our understanding of learning impairments in schizophrenia and open new approaches to therapeutic discovery.5–8

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References


